

APPLICATION FOR UNITED STATES PATENT
FOR

Asynchronous Software Update

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of data processing. More
10 specifically, the present invention relates to the distribution and updating of
software.

2. Background Information

With advances in microprocessor, networking and telecommunication
15 technologies, increasingly computing devices are networked together through
private and public networks, such as the Internet. As a result, for improved
operational efficiency, increasingly software vendors prefer to distribute software
products, including updates, online.

Typically, a client computer would periodically check in with a central server
20 of a software vendor, when the client computer is connected online, and exchange
information with the server, to allow the server to determine if the client computer's
installed software supplied by the software vendor needs to be updated. If it is
determined that update is necessary, the user of the client computer will be so
informed, and asked whether the user would like to have the software updated. If
25 the user agrees to the update, the updates would be downloaded immediately, and
the software in turn would be updated immediately thereafter. During the download
and re-installation, the client computer would be occupied and unavailable for

normal usage by the user. If the user does not want to have the software updated at the time, the updates would not be downloaded, and as a result, the software would not be updated. The user will be prompted again next time when client computer is connected online again.

5 These prior art techniques suffer from a number of disadvantages. As described earlier, the download is performed immediately when the user agrees to the update, and the user's computer is tied up during the download and re-installation, just when the user wants to do some productive work, which is often the reason why the user goes online. As a result, many users would decline to accept
10 the update offer. Thus, under the prior art techniques, there are often more down level versions of the software being deployed than otherwise necessary. Moreover, overtimes, the repeated prompting of the user to update the software can become annoying to the user. Further, the prior art techniques are not scalable to support a very large number of users, as the server capacity necessary to provide immediate
15 download to hundreds of thousands of consenting users in a responsive manner is prohibitively costly.

Thus, an improved approach to software distribution/update is desired.

20 SUMMARY OF THE INVENTION

A server is equipped with a distributor/updater to accept periodic check in by client computers to determine if the client computers' software needs to be updated. The distributor/updater is designed to provide each client computer, determined to
25 require update, with a task list listing a number of tasks to be asynchronously performed at a later point or later points in time by the client computer to update the client computer's software. The tasks may include asynchronous subsequent

requests of the server or third party servers for software parts. The tasks also include installation tasks to be performed upon obtaining the required software parts. The client computer is also equipped with a complementary distributor/updater to perform the periodic check-in and to schedule the update tasks accordingly. In one embodiment, the server's distributor/updater is also designed to be able to regulate its own workload, optionally asking parts requesting clients to retry later.

10 BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

15 **Figures 1a-1b** illustrate an overview and a method view of the present invention, in accordance with one embodiment;

Figures 2a-2b illustrate the operational flow of the relevant aspects of the distributor/updater (client side) of **Fig. 1**, in accordance with one embodiment;

20 **Figure 3** illustrates an example update task list, in accordance with one embodiment;

Figures 4a-4b illustrate the operational flow of the relevant aspects of the distributor/updater (server side) of **Fig. 1**, in accordance with one embodiment;

25 **Figures 5a-5b** illustrate various example data organizations suitable for use to store the various software and client related information for practicing the present invention, in accordance with one embodiment; and

Figure 6 illustrates an example computer system suitable for use to practice the present invention, in accordance with one embodiment.

DETAILED DESCRIPTION OF THE INVENTION

5 In the following description, various aspects of the present invention will be described. However, it will be apparent to those skilled in the art that the present invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However,
10 it will also be apparent to one skilled in the art that the present invention may be practiced without the specific details. In other instances, well known features are omitted or simplified in order not to obscure the present invention.

15 Parts of the description will be presented in terms of operations performed by a processor based device, using terms such as data, tables, requesting, determining, retrieving, and the like, consistent with the manner commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. As well understood by those skilled in the art, the quantities take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and otherwise manipulated through mechanical and electrical components of the
20 processor based device; and the term processor include microprocessors, micro-controllers, digital signal processors, and the like, that are standalone, adjunct or embedded.

25 Various operations will be described as multiple discrete steps in turn, in a manner that is most helpful in understanding the present invention, however, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations need not be performed in the order of presentation. Further, the description repeatedly uses the phrase "in

one embodiment", which ordinarily does not refer to the same embodiment, although it may. Also, the term "software part" will be used, and the term as used herein is intended to include a broad range of software "parts", including but are not limited to patches, modules, routines, components, objects, in source or object form.

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Overview

Referring now first to **Figures 1a-1b**, wherein two diagrams illustrating an overview and a method view of the present invention, in accordance with one embodiment, are shown. As illustrated in **Fig. 1a**, in accordance with the present invention, software supplier **102** (more specifically, its' computing equipment) is provided with distributor/updater (server side) **110** of the present invention, while a number of clients **132** (more specifically, their computing equipment) are each provided with a copy of distributor/updater (client side) **134** of the present invention, to facilitate distribution/update of the software of software supplier **102** installed on clients **132**. In addition to the software code **106** itself (stored and managed through e.g. code control library **104**), for the practice of the present invention, software supplier **102** (more specifically, its computing equipment) is also provided with software update and client databases **107** and **108** for storing various relevant software update and client related information.

Further, as will be described in more detail below, the software update method of the present invention may also advantageously involve third party software, as illustrated by the presence of third parties **122**. Third parties **122** (more specifically, their computing equipment) are provided with their corresponding software **126**, controlled and maintained e.g. by code control library **124**.

Software supplier **102**, third parties **122** and clients **132** are coupled to each other via communication link **142**, which is intended to represent a broad range of communication links, including but are not limited to public as well as private,

wireline and/or wireless, local/wide area networks. In one embodiment, software supplier **102**, third parties **122** and clients **132** are coupled to each other via the Internet.

As illustrated in **Fig. 1b**, in accordance with the present invention, clients **132**,

5 using distributor/updater (client side) **134** would periodically check in with software supplier **102** to facilitate determination whether the software of software supplier **102** installed on the computing equipment of clients **132** needs to be updated, block **152**. In response, clients **132** determined to require update, are each provided with an update task list by distributor/updater (server side) **110** of supplier **102**, block **154**.

10 The update task list enumerates a number of update tasks to be asynchronously performed by clients **132** at a subsequent point or points in time to effectuate the update. Thereafter, at the subsequent point or points in time, typically times that are more convenient to the users of clients **132**, clients **132**, using distributor/updater (client side) **134**, would asynchronously perform the specified update tasks, block **156**. The specified update tasks may include re-contacting the server/servers of software supplier **102** or contacting the server/servers of third party suppliers **122** to retrieve required software parts, and the installation tasks, such as compilations, linking or registry updates to be performed, upon retrieving the required software parts. Upon retrieving all the required software parts, clients **132**, using

15 distributor/updater (client side) **134**, would asynchronously perform the specified installation tasks, causing the installed software of software supplier **102** to be updated and re-installed for usage, block **158**.

Accordingly, the present invention advantageously allows the update to be performed at times that are more convenient to the users of the client computers,

20 which in turn would encourage more users to accept the update offers. As a result, it is expected that less users will be operating with down level versions of the software, which in turn would reduce maintenance cost, and increase user

satisfaction. The present invention also advantageously allows the update to involve update of dependent software parts supplied by third party suppliers, thereby increasing the range of updates that may be performed, as well as reducing the burden and complication of having a software supplier supplying special

5 modified versions of other third party's software. Further, as will be appreciated from the description to follow, by performing the update tasks asynchronously and allowing the supplier servers to defer servicing of parts requests, the present invention is much more scalable to support very large number of client computers.

In one embodiment, upwards of hundreds of thousands client computers will be

10 supported.

The communication between software supplier **102**, third parties **122** and clients **132** may be conducted using any one of a number of communication techniques/protocols known in the art. Different protocols may be employed for communication with different parties. In one embodiment, the communication is

15 conducted using the HTTP message protocol, signaled in accordance with the TCP/IP communication protocol.

Code control library **104** and **124** are intended to represent a broad range of code control libraries known in the art, accordingly will not be further described. Distributor/updater (server/client side) **110** and **134**, including their operational flows and interactions with each other, as well as software update and client databases

20 **107** and **108** will be described in turn below.

[Note that it is immaterial whether software supplier **102** supplies the software for a fee or for free.]

Distributor/Updater (Client Side)

Figures 2a-2b illustrate the operational flow of the relevant aspects of distributor/updater (client side) **134** of **Fig. 1a**, in accordance with one embodiment.

As illustrated in **Fig. 2a**, upon invocation or start up, distributor/updater (client side)

- 5 **134** determines if host client computer **132** is connected on-line, block **202**. If host client computer **132** is not connected on-line, distributor/updater (client side) **134** would re-schedule itself to be re-invoked/re-started at a later time to attempt the check-in again, block **210**. However, if host client computer **132** is connected on-line, distributor/updater (client side) **134** checks in with software supplier **102** to
- 10 facilitate determination whether the installed software of software supplier **102** on client computer **132** needs to be updated, block **204**. Next, distributor/updater (client side) **134** determines if the check-in resulted in client computer **132** being provided with an update task list, block **206**. If client computer **132** is provided with an update task list, distributor/updater (client side) **134** schedules subsequent
- 15 performance of the enumerated update tasks, block **208**. Thereafter, distributor/updater (client side) **134** re-schedules itself to be re-invoked/re-started at a later time for the next check-in, block **210**.

The on-line determination may be made in any one of a number of known techniques, e.g. by “pinging” software supplier **102** or other pre-determined servers.

- 20 The update determination may be made in one of a number of alternative manners. In one embodiment, during the check in process, distributor/updater (client side) **134** identifies itself as well as informs distributor/updater (server side) **110** of software supplier **102** of the version level of the installed software of software supplier **102**, and distributor/updater (server side) **110** of supplier **102** authenticates the checking in client **134**, compares the reported version level with the latest
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version level available, and informs distributor/updater (client side) **134** whether the installed software needs to be updated or not.

In alternate embodiments, software supplier **102** keeps track of the version level of its software installed on the various clients **132**. Thus, during the check-in process, distributor/updater (client side) **134** merely identifies itself to distributor/updater (server side) **110** of supplier **102**, and distributor/updater (server side) **110** of supplier **102** having knowledge of the version level of the installed software on the reporting client **132** would simply inform distributor/updater (client side) **134** whether the installed software needs to be updated or not, upon authenticating the checking in client **132**.

In yet other embodiments, during the check-in process, distributor/updater (server side) **110** of supplier **102** informs distributor/updater (client side) **134** of the latest version of the installed software available, and distributor/updater (client side) **134** would make the determination whether update is necessary. Authentication of checking in clients **132** may be deferred (e.g. to the time when a client **132** requests for update software parts).

In other embodiments, distributor/updater **110/134** maintains the last check-in date and the time period for checking in with software supplier **102**, and distributor/updater **110/134** uses the check-in timing information (in addition to or in lieu of the versioning information) to make the update determination. The time period between check-ins may vary for different software. Some software may have shorter periods in between check-ins, while others have longer periods in between check-ins.

Scheduling for the re-invocation/re-start of distributor/updater (client side) **134** may be made in any one of a number of known techniques, e.g. using scheduling

service of an underlying operating system. In various embodiments, the check-in periodicity is initially configured when distributor/updater (client side) 134 is first installed on a client computer 132. Thereafter, the check-in periodicity may itself be periodically updated. In some embodiments, it is updated by distributor/updater

5 (server side) 110 each time distributor/updater (client side) 134 checks in. In one embodiment, the next check-in time is also enumerated as part of a returned update task list. For this embodiment, the update task list is always returned (although it may contain only “administrative” information, such as the next check-in time, with no substantive update tasks to be performed). Typically, if re-scheduling is

10 necessary after the check in period is up, e.g. because client 132 is connected on-line, distributor/updater (client side) 134 would re-schedule itself to be re-invoked/re-started in a relatively short time period to re-attempt the check-in. Obviously, the time period within which distributor/updater (client side) 134 is to retry to determine if client computer 132 is online is application dependent. Preferably, the user may

15 control its length through one or more user controllable operating parameters.

In some embodiments, the present invention may be practiced with distributor/updater (server side) 110 (through distributor/updater (client side) 134) prompting the user of client 132, for acceptance, before providing the update task list (upon determining that update is necessary). In other embodiments, the update

20 task list may be provided responsively without initially prompting for the user's consent. The user's consent may be prompted at a later time by distributor/updater (client side) 134 when the update tasks are to be performed.

In one embodiment, with respect to the scheduling of the update tasks to be subsequently performed, distributor/updater (client side) 134 merely schedule

25 performance of the first task (as opposed to all tasks to be performed), and the subsequent tasks are successively scheduled after a prior task is completed.

Typically, the task or tasks are scheduled to be performed at a time that is convenient for the user, e.g. during the third shift period from mid-night to 6 am. Preferably, the user convenient time periods are user defined, which may be specified in any one of a number of user configuration techniques known in the art.

5 Skipping briefing to **Figure 3**, wherein a block diagram illustrating an outline of an update task list of the present invention, in accordance with one embodiment is shown. As illustrated, example update task list **300** includes a number of software part retrieval instructions **302**, and a number of post-retrieval installation instructions **304-308**. For the illustrated embodiment, each software part retrieval instruction
10 **302** includes a source where the software part is to be retrieved, and an identifier of the part. The source information may include identification of a server as well as identification of a file directory on the server, within which the software part may be found. In one embodiment, the information is expressed as a uniform resource locator (URL). As alluded to earlier, the source for the software part may be the
15 software supplier itself or it may be another third party (e.g. in the situation where an updated dependent software part is required).

As illustrated, post retrieval installation instructions may include compile/link instructions **304**, execution instructions **306**, and registry/database update instructions **308**. Compile/link instructions **304** specify certain compilation/linkage tasks to be performed. Each such instruction **304** includes the compiler/linker to be employed, and identification of the part to be compiled/linked. Execution instructions **306** specify execution of certain install or other related programs. Finally, registry/database instructions **308** specify entries to be made into certain operating system registry or control databases.

These instructions may be expressed in a proprietary format understood only by distributor/updater (client side) 134, or it may be expressed using any one of a number of programming/script languages, such as C, Java, JavaScript or PERL, and the like.

5 Referring now to **Figure 2b**, where the operational flow of the task performance aspect of distributor/updater (client side) 134 of **Fig. 1a** is shown, in accordance with one embodiment. As illustrated, upon having been invoked/started to asynchronously perform the enumerated update tasks, distributor/updater (client side) 134 first determines if client 132 is connected on-line, block 222. If client 132
10 is not connected online, for the embodiment, distributor/updater (client side) 134 reschedules itself to be re-invoked/re-started at a later point in time, block 223. In one embodiment, distributor/updater (client side) 134 would attempt to cause client 132 to be connected online, and reschedules itself only upon failing to connect client 132.
15 Upon determining client 132 is connected online or causing it to be connected on-line, distributor/updater (client side) 134 would attempt to contact a server of software supplier 102 (or a third party) to attempt to retrieve the next required software part (as specified by the task list), block 224. Next, distributor/updater (client side) 134 determines if it was successful in making the
20 retrieval, block 226. If distributor/updater (client side) 134 was successful, distributor/updater (client side) 134 accumulates the retrieved part, block 228. Thereafter, distributor/updater (client side) 134 determines if all specified parts have been retrieved. On the other hand, if distributor/updater (client side) 134 was unsuccessful in retrieving a part, distributor/updater (client side) 134 would “mark”
25 the part to be retrieved for retry at a later time, block 230.

Upon determining not all specified parts have been retrieved or upon marking a part for retry at a later time, distributor/updater (client side) 134 determines if there are more parts to retry now, block 234. If more retrievals are to be attempted, the process continues back at block 222, otherwise, the process continues back at 5 block 223.

Eventually, distributor/updater (client side) 134 would determine at block 232 that all specified parts have been retrieved. At such time, distributor/updater (client side) 134 would proceed and perform the specified installation tasks, which may include compiling and/or linking certain retrieved parts as well as updating system 10 “configuration” registry/database, and so forth. The terms “compiling” and “linking” are used herein in a general sense to represent the typical set up operations performed to ready executables for execution.

Distributor/Updater (Server Side)

15 **Figures 4a-4b** illustrate the operational flow of the relevant aspects of distributor/updater (server side) 110 of supplier 102 of **Fig. 1a**, in accordance with one embodiment. As illustrated in **Fig. 4a**, upon contacted by a client 132 checking in to determine whether the installed software of the supplier on client 132 needs to be updated, distributor/updater (server side) 110 of supplier 102, together with its 20 counterpart distributor/updater (client side) 134, cooperatively make the determination, block 402. As described earlier, the determination may be made by distributor/updater (server side) 110, distributor/updater (client side) 134, or jointly. If it is determined that update is not necessary, checking in client 132 is notified accordingly, block 406. However, if it is determined that update is necessary, 25 distributor/updater (server side) 110 provides its counterpart, distributor/updater

(client side) 134, with the earlier described update task list, block 404. In one embodiment, the update task list is selected from a number of pre-generated update task lists listing the update tasks necessary for various combinations of the down level versions and computing environment factors. For examples, a first pre-generated task list would list the update tasks to be performed if a client is updating from the most current level minus one, executing with processor family A and operating system version x, a second pre-generated task list would list the update tasks to be performed if a client is updating from the most current level minus two, executing with the same processor and operating system combination, a third pre-generated task list would list the update tasks to be performed if a client is updating from the most current level minus one, executing with processor family B and operating system version y, and so forth.

In addition to processor family and operation system versions, computing environment factors may also include other hardware/software factors, such as the type of audio/video device/driver used, the type of network adapter and networking protocol employed, and forth. In these embodiments, where the computing environment factors are considered in the provision of the update task list, the computing environment metrics of a checking in client may be pre-provided by the client 132 during a registration service, and maintained by software supplier 102. Alternatively, the computing environment information may be provided by client 132 each time it checks in with software supplier 102.

As illustrated in Fig. 4b, upon having been subsequently contacted by a requesting client 132, for the embodiment, distributor/updater (server side) 110 of supplier 102 determines if the request is to be serviced immediately, block 412. If distributor/updater (server side) 110 determines the request is not to be serviced immediately, distributor/updater (server side) 110 would ask its counterpart,

distributor/updater (client side) 134 to retry later, block 414. However, if it is determined that the request is to be service immediately, distributor/updater (server side) 110 returns the requested part/parts to client 132, block 416.

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Sample Data Organizations

Figures 5a-5b illustrate two example data organizations suitable for use to implement databases 107 and 108 of **Fig. 1** to store the software and client related information for practicing the present invention, in accordance with one embodiment. As illustrated in **Fig. 5a**, software related table/view 500 includes column 502 for 10 storing the software identifiers (for a software supplier supplying multiple software “packages”). Table/view 500 also include columns 504, 506 and 508 for storing “old” version identifiers of the various software, various environmental metrics that are relevant in determining the update actions, and task list identifiers identifying the update task lists for the corresponding combinations of “old” version and the 15 environmental metrics. As alluded to earlier, examples of computing environmental metrics include but are not limited to processor family type, operating system levels, and so forth. As shown, table 500 may also include other columns, such as column 509, for storing other data.

Similarly, as illustrated in **Fig. 5b**, client table/view 520 includes column 522 20 and columns 524 for storing client identifiers, and the clients’ basic information, such as their IP addresses, user names, addresses, phone numbers, fax numbers, email addresses, and so forth. Client table/view 520 further includes columns 526 for storing various computing environment metric information that are relevant in determining the update actions. Table/view 520 may also include other columns, 25 such as column 529 for storing other client related data.

In one embodiment, tables/views **500** and **520** are relational tables/views of one or more relational databases. In alternate embodiments, other equivalent data structures may be used instead.

Further, in alternate embodiments, the present invention may also be

5 practiced with the software supplier maintaining more or less client related information. Client information employed in the selection of the update task list that are not maintained by the software supplier may be provided by the client during the check in process instead.

10

Example Computer System

Figure 6 illustrates an example computer system suitable for use as a server to host the category name service (and optionally, the supplemental services) of the present invention, in accordance with one embodiment. As shown, computer system **600** includes one or more processors **602** and system memory **604**.

15 Additionally, computer system **600** includes mass storage devices **606** (such as diskette, hard drive, CDROM and so forth), input/output devices **608** (such as keyboard, cursor control and so forth) and communication interfaces **610** (such as network interface cards, modems and so forth). The elements are coupled to each other via system bus **612**, which represents one or more buses. In the case of

20 multiple buses, they are bridged by one or more bus bridges (not shown). Each of these elements performs its conventional functions known in the art. In particular, system memory **604** and mass storage **606** are employed to store a working copy and a permanent copy of the programming instructions implementing the distributor/updater (the server side or the client side) of the present invention. The

25 permanent copy of the programming instructions may be loaded into mass storage **606** in the factory, or in the field, as described earlier, through a distribution medium (not shown) or through communication interface **610** (from a distribution server (not

shown). The constitution of these elements **602-612** are known, and accordingly will not be further described.

Conclusion and Epilogue

5 Thus, it can be seen from the above descriptions, a novel method and apparatus for asynchronously updating software has been described. The novel method/apparatus is advantageously scalable to support a very large number of client computers requiring software update services.

10 While the present invention has been described in terms of the above illustrated embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments described. The present invention can be practiced with modification and alteration within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of restrictive on the present invention.

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